Mini Review

Breeding Methods to Obtain Superior Genotypes of Okra

ABSTRACT

The culture of okra, although little known, exhibits an interesting trade in relation to other vegetable crops. This is mainly due to its sensorial and nutritional qualities. However, despite their importance, there are still almost no breeding programs aimed at obtaining superior genotypes, much of this is due to complications in the use of breeding methods for this culture. The objective of this work was to prepare a literature review for improved accuracy improvement of methods for obtaining superior genotypes of okra. Based on the present literature the choice of the most appropriate method for each characteristic can result in superior lineages.

Keywords: Abelmoschus esculentus, precocity of culture, yield of pod, quality of fruits.

1. INTRODUCTION

The okra (*Abelmoschus esculentus* L. Moench.) is a vegetable of great social and economic importance for several regions of the world, being mainly cultivated in the tropics, subtropics and hot regions of temperate zones [1-2]. In Brazil, the okra finds ideal conditions for its cultivation in the region Northeast and Southeast of the country [3].

The productivity of cultivated okra crop varies between 15 and 22 tonne/ha, under Brazilian conditions. It can be cultivated **in** for good yield throughout the year. Such culture presents attractive characteristics in cultivation and consumption, such as ease of management, relatively fast vegetative cycle, high food value, great utility and high profitability. Despite the importance of this culture, the search so much in general, as in the area of plant breeding is still incipient [4].

Thus it becomes necessity to develop early varieties, productive and fruit quality for farmers, as an alternative to hybrid varieties, mainly due to the low level of technology that the producers have. According to [5], besides good production, plants with greater maturity or more precocious are desirable in cultivars of okra, since they exceed the vegetative phase in a shorter time, reducing the period of exposure of the plant to the attack of diseases and pests. This advantage is reflected in the possibility of commercialization of the product before cultivars of normal cycle, being able to obtain better prices. In this context, researchers [6] report that the development of new varieties is one of the technologies that increases productivity and stabilizes production, without additional costs to the farmer.

For the development of a well-structured breeding program, it is essential to know how to choose the best parents in relation to the characteristics of interest for breeding [7]. The use of methodologies for this purpose represent excellent tools to aid the breeder in obtaining promising segregating populations for obtaining good lines. According to [8] several methodologies the selection genitors can be used, among them the diallel crosses **allow**, which allow the obtaining of basic information regarding the parents to initiate a program of genetic improvement for the culture of the okra, so much for the production of self-pollinating varieties, as for the production of hybrid varieties. In possession of the best combination of parents, an appropriate improvement method should be used to drive the segregating population, for **the possible** obtaining **of** good progenies, that can be evaluated in preliminary tests, until arriving at a new variety [9].

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The objective of this work was to perform review a literature review to support the establishment of a future breeding program for the production of early varieties, productive and quality varieties through consultation of scientific articles that deal with the subject in question.

2. GENERAL ASPECTS OF CULTURE OF OKRA

The okra belongs to the family Malvaceae, being the only relevant oleraceous culture within this family, presenting great importance for regions with semi-arid conditions because it is a vegetable adapted to this condition. It is a crop exploited mainly in Asia, Africa, America and in the Mediterranean regions [10].

The origin of okra is still unclear, with most authors citing Africa, possibly in Ethiopia [11], in every way this culture presents important centers of genetic diversity, which include West Africa, India, and Southeast Asia [12-13].

The cultivated species of okra is considered polyphyletic, since it is believed that its origin came from more than one species. The main hypothesis regarding this information is the variation of the number of chromosomes in the genus that presents about 10 known species [14-15].

In relation to cytogenetics, as previously reported there is considerable variation in the number of chromosomes and also in levels of ploidy both among the species of the genus Abelmoschus, how much within the cultivated species, it has been observed more frequently in *Abelmoschus esculentus* (L.) Moench 2n = 130, however, some authors such as [14], reported the existence of 2n = 72, 108, 120, 130 and 144 chromosomes.

Depending on the location, this culture is known by different denominations: gumbo, gombô, okra, ladys fdinger (English), bhindi or bhendi (Indian), bamyah or bamiat (Arabic), quimbombo (Spanish) [16].

The okra is considered an annual plant, which is characterized by being shrub, of erect postage and semi-woody stem that can reach three meters of height, the plant shows the greenish or greenish coloration with reddish areas, despite this size, in this plant lateral branches can still occur, which are stimulated by management practices in the cultivation, such as the use of larger spacings [17]. The leaves are large, with deeply cut limbus, lobed and with long petioles [17].

The okra is a culture that has its propagation via seeds, being more usual its planting in direct sowing, where it is considered an intermediate species with 4-19% cross-pollination, their flowers facilitate the crossing process by the fact that they are yellow and large (4 to 8 cm in diameter), the anthesis occurs most often between 06:00 hs and 10:00 hs.

The fruits of the okra measure about 25 cm, with five locules, and hairy, are capsule type, plump, presenting circular or pentagonal cross-section, its production occurs even when the plant is small both on the main stem and on the sides, depending on the cultivar, there is the production of medium and short fruits with protruding angles or with almost circular section, in general have the pyramidal shape, with average yield of 60 seeds [18].

The development of the culture of the okra is quite variable in relation to the duration of the vegetative and reproductive periods, being very influenced by the cultivar used., Hhowever, in general, the vegetative stage lasts from the emergencey until about 60 days after sowing, then begins the reproductive stage that goes up to 120 days after sowing., Iit is worth emphasizing that the planting season influences the cycle of this culture intensely, because the reports that the fruiting period exceeded 200 days [3].

The harvest of the fruits is performed several times, the aspect observed should be soft or tender fruit with bright green coloration. In hot times the harvest begins with five to six days after the opening of the flower, and in the winter with six to seven days after the opening of the flower. Harvesting is usually manual, at least twice a week, being ideal to harvest on alternate days [16].

Despite the importance of the okra, there are few institutions that work with this culture, and this gets worse when is taking into account breeding programs.

3. IMPROVEMENT FOR PRECOCITY, PRODUCTION AND QUALITY

For the improvement of any crop, it is necessary to gather in the varieties, a series of not only productive characters, but also**such** the **of** quality, to meet the demands of producers and consumers. In the okra, characters such as precocity, production and quality are indispensable.

The selection of early materials of okra facilitates the cultivation of this vegetable in regions scarce of financial and natural resources. Early cultivars may be part of the variety management strategy, because these if compared with cultivars of normal cycle, the influence the marketing of the product, because its obtaining is faster, reflecting the possibility of marketing strategies, and in the field makes it possible to obtain a product of better quality, reducing the exposure of the okra to the biotic and abiotic intemperies [5].

The researchers [19], report that the importance of the precocity variable of harvest, is evidenced besides the agronomic advantages, because the early harvest facilitates the hiring of labor at the beginning of the harvest which is a critical period, this being a great economic advantage, because it allows economic return at the beginning of the activity.

The use of early cultivars allows the concomitant increase of fruit production [5], besides this increase by planting, early cultivars allow a greater amount of cultivation of this vegetable, allowing greater return over time. It is worth noting that despite this interesting relationship to arrive at a productive and precocious variety, these characters are strongly influenced by the environmental component [20], thus requiring, according to [5] of improvement methods that use greater control of the environment, such as those presenting progeny testing, the selection according to [21], should be performed using populations with large numbers of individuals, so that the maximum of recombinations occurs due to the large number of chromosomes of this species. Besides the possibility of the improvement of the okra by means of the obtaining **of** segregating populations, there is also the possibility of exploitation of vigor of hybrid in F_1.

In plant breeding, in addition to meeting productive needs, by means of the attributes of precocity and productivity in okra, it is necessary to develop quality products, which are well accepted, being the fiber content and the coloring of the okra fruit, two important parameters in this segment.

The okra fruits should be marketed new and tender, because with its complete development occurs the increase of the fiber content until a certain limit, the ideal is that the harvest point of the okra is when the fiber content is less than 6.5%, being tender and having a size of 10 to 14 cm, after these values, the in nature consumption of this vegetable becomes inadequate [16]. The fiber content and coloration varies greatly between the different okra cultivars, being interesting, their evaluations in breeding programs. In general, the cultivars of North America have a higher fiber content than the indigenous cultivars [2].

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4. DIALLELIC ANALYSIS IN THE CHOICE OF PARENTS

The choice of parents, not always the most productive agronomically are those that have the best combination capacity to be used in breeding programs. In this way, the genetic analysis of parents is used to identify the best combinations for the precocity, production and quality[22-23].

In the genetic analysis for the choice of parents [8], cites several methodologies, among them, diallel crosses are the most widely used in almost all cultivated species in obtaining promising segregating populations, and this stage is fundamental to succeed in the subsequent stages of the breeding program [24].

Depending on the complexity, there are several types of dialleles which have been used: 1. Complete or balanced dialleles - are those that include the hybrids in generation F_1 or F_2 or any generation among all pairs of combinations of the parents; 2. Circulating dialleles - in which the parents are represented in the hybrid combinations in a smaller number of crosses than in the other types; 3.

Unbalanced dialleles - are those that some programmed hybrid combinations are not obtained; 4. Incomplete dialleles - are those that the progenitors are represented by a variable number of crossings; 5. Partial dialleles - those involving two groups of parents [8-25].

According to [25], there are some more used methodologies of analysis of a diallel, among them can be cited: [26] that evaluates the effects and sums of squares of effects of the general and specific capacity of combination; [27] evaluating the effects of varieties and varietal heterosis; and the proposal by [28] that informs on the inheritance of the character, genetic values of the parents and the selection limit.

Partial diallel analysis has the objective of studying the obtaining of favorable phenotypes that are found in different groups of parents, not being of interest the combinations within each group, as well as the factorial model proposed by [29-30].

According to [8], the use of the methodology of diallel crosses, allows the selection of parents from the estimates of General combining ability and specific combining (GCA and SCA), seeking to identify those with high estimates of these parameters, thus, segregating populations of these parents are expected to have a high average and expressive genetic variability, these parameters are fundamental for the extraction of lineages in segregating populations. In general, the general combining ability (GCA) is very useful for directing future hybridization works, because it is expected that individuals with a high value of this parameter will allow good hybrid combinations with the other parents [31].

The okra is considered an autogamous plant, in the improvement thereof the self-pollinated methods can be used or can exploit the heterosis. For both situations, it is necessary to know how to select the best parents that allow the best combinations [32]. According to [9], the heterosis **this** or hybrid vigor is the increase of progeny performance in relation to the parents, due to the crossing between contrasting individuals, this phenomenon in the culture of the okra was studied by some authors [33-34-35], which verified productive increase in several characters of the culture.

5. METHODS OF DRIVING OF SEGREGATING POPULATION AND PRELIMINARY PROGENY EVALUATION

With the variability generated from the best combination of parents, one of the appropriate methods of conducting segregant populations should be used for autogamous plants for the extraction of advanced lines. According to [9], the methods are classified in two ways, first in those that do not separate the phase of endogamy and selection, which are mainly included the mass method and the genealogical method, in which starting of generation F_2 when variability already exists the selection starts. Secondarily the other methods, which separate these two phases.

Particularly the genealogical method known as the pedigree method was proposed by Hjalman Nilsson, being very popular for the development of lines of autogamous species. But over the years it has been replaced by other methods such as the single seed descent method [9]. Even so, that is of great importance and is used until the present day. In this method the whole genealogy of the plants is annotated to support selection, providing accurate kinship relationships among progenies [36].

According to [37], the method involves the following phases: 1. Crossing between two or more varieties; 2. Selection of a large number of individual plants in generation F_2; 3. Planting of the progenies of the individual plants by selecting between and within until the generation F_4 and F_5 in which selection can be initiated only among the progenies, by the attainment of the accentuated homozygosity; 4. Carry out the production and quality tests for two or three years to choose the progenies that will constitute the new varieties.

6. CONCLUSION

Based on the literature, several important elements were identified in relation to okra breeding and culture, taking into account the aspects from the correct selection of the parents to the early evaluation of the lineages.

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